STATE OF NEW YORK
HUGH L. CAREY, Governor
DEPARTMENT OF TRANSPORTATION
WILLIAM C. HENNESSY, Commissioner
1220 WASHINGTON AVE., STATE CAMPUS, ALBANY, NEW YORK 12232

ASPHALT CEMENT TESTING PROGRAM
FALL 1979

REPORT PREPARED
APRIL 1980

materials
bureau
technical
services
subdivision

TABLE OF CONTENTS

ASPHALT CEMENT TESTING PROGRAM
FALL 1979

Report Prepared By
The Materials Bureau
April 1980

Introduction

Nineteen asphalt cement samples were collected at asphalt plants by Personnel of the Materials Bureau during September and October 1979.

These samples include six AC-10, nine of AC-20 and four of 85-100 grade. These samples represent many sources which had supplied material to the Department during 1979. The specific lots of material collected represent normal, Canadian, Boscan and Mid-Continent crude sources.

The supplier, location, crude source and lot numbers are tabulated below:

AC-10

Supplier	Location	Lot	Crude Source
Arco	Albany	46/47	Normal
Ashland	Tonawanda	34	Normal
Exxon	Bay Way	-	Normal
Marathon	Tonawanda	9	Mid-Continent
Petrofina	Montreal	-	Normal
United Ref.	Warren	25	Normal

AC-20

Supplier	Location	Lot	Crude Source
Arco	Phila.	-	Normal
Ashland	Tonawanda	15	Normal
Chevron	Perth Amboy	40	Boscan
Exxon	Bay Way	-	Normal
Marathon	Tonawanda	8	Mid-Continent
Petrofina	Montreal	-	Normal
United Ref.	Warren	27	Normal
West Bank	Kearney	4	Boscan
West Bank	Pennsauken	1	Normal

85/100

Supplier	Location	Lot	Crude Source
B. P. Oil	Montreal	23/24	Canadian
Gulf	Montreal	-	Normal
Petrofina	Montreal	23	Normal
Shell	Montreal	3	Normal

All specification tests were performed on the nineteen samples. These were:

$140^{\circ}F$ viscosity
$275^{\circ}F$ viscosity
$77^{\circ}F$ penetration
loss on heating after thin film oven
$60^{\circ}F$ ductility after thin film oven
viscosity ratio after thin film oven
flash point $^{\circ}F$
solubility in triclene

Additional non specification tests were performed:

$39.2^{\circ}F$ penetration
penetration ratio: $39.2^{\circ}F/77^{\circ}F$
77° ductility after thin film oven
77° penetration after thin film oven
penetration ratio after/before thin film oven
$39.2^{\circ}F$ ductility original sample

A penetration viscosity number (PVN) has been computed for each asphalt cement sample.

In addition some new tests were included.

These were settlement test and chemical analysis.

This testing program was similar to the program conducted on asphalt cements in 1978 with some changes:

1. Samples were collected at the plants by Materials Personnel.

2. The program was enlarged to include the settlement test and chemical analysis.

Test Results

General

Six samples fell outside specification limits:

All six were from normal crudes.

One AC-10 with viscosity at 140°F of 1212(*) and penetration of 63 at 77°F.

Three AC-20:

One with penetration of 56 at 77°F and T.F.O.T. ductility of 15.5 at 60°F.

One with T.F.O.T. ductility of 22 at 60°F.
One with penetration of 56 at 77°F.
Two of 85/100 Grade:
One with penetration of 82(*) at 77°F
One with penetration of 84(*) at 77°F

(*) indicates substantial conformance

A. 140°F viscosity

Of the 19 samples, there was one AC-10 failure at 1212 poises.(*)

140°F Viscosity Tests

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	1062	1882	1404
Range	995-1212	1689-2116	1252-1743
Standard Deviation	79.6	174	228

Certified Results Were

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	1068	1878	1487
Range	976-1207	1720-2201	1296-1932
Standard Deviation	77.4	175	299

B. 77°F penetration

There were 5 out of specification
Results:

One AC-10 @63
Two AC-20 @56
Two 85-100 @82(*), 84(*)

Penetration Tests at 77°

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	95	71	85
Range	63-120	56-81	82-89
Standard Deviation	22.7	9.4	3.0

Certified Results

Mean	101	73	88
Range	66-121	55-79	83-90
Standard Deviation	22.2	8.5	3.3

C. 275°F viscosity None out of Specs.

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	300	401	350
Range	270-316	365-437	321-391
Standard Deviation	17.4	27.3	29.7

D. Penetration @ 39.2°F

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	31	24	29
Range	19-40	17-30	28-31
Standard Deviation	9.4	4.4	1.5

E. Pen Ratio 39.2°F/77°F

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	32	33	34
Range	30-37	30-41	31-37
Standard Deviation	2.8	3.4	2.8

F. Thin Film Oven Loss (samples which showed weight gains reported as no loss)

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	.05	.05	.01
Range	.03-.153	.007-.25	0-.036
Standard Deviation	.06	.08	.02

G. Thin Film Ductility @ 60°F

Two AC-20 with values of 15.5, 22 were out of specifications limits.

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	121	67	91
Range	54.5-150	15.5-144	45-150
Standard Deviation	39	44.9	45

H. Thin Film Ductility @ 77°F

All samples were over 150 cm.

I. Thin Film Oven Viscosity Ratio at 140°F

All samples were within specification.

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	2.1	2.2	2.1
Range	1.8-2.3	1.9-2.4	1.9-2.3
Standard Deviation	0.2	0.3	0.2

J. Thin Film Oven Penetration @ 77°F

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	62	47	57
Range	49-75	39-52	56-58
Standard Deviation	10.3	4.8	1.0

K. Thin Film Oven Penetration Ratio @ 77°F

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	67	67	67
Range	61-78	61-71	64-69
Standard Deviation	6.4	3.8	2.0

L. Ductility (original) @ 39.2°F

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	10.9	6.1	7.5
Range	5.25-19.5	3.75-7.00	7.0-8.5
Standard Deviation	5.1	1.2	0.7

M. Ductility (original) @ 77°F

All samples were over 150 cm.

N. Flash Point °F

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	598	608	615
Range	543-645	572-647	588-647
Standard Deviation	39	30	25

O. Solubility

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	99.87	99.89	99.87
Range	99.81-99.94	99.81-99.95	99.79-99.94
Standard Deviation	.05	.05	.06

P. PVN

The penetration-viscosity number, PVN, is an indicator of the temperature susceptibility of asphalt cements. It is suggested that an asphalt cement with a PVN less than -.05 is temperature susceptible.

$$PVN = \frac{\text{Log A} - \text{Log V}}{\text{Log A} - \text{Log B}} \; X(-1.5)$$

Where Log A = 4.25800 - .79674 Log (77°F penetration)
Log B = 3.46289 - .61094 Log (77°F penetration)
Log V = Log (275°F viscosity)

The results indicate that most of these cements are temperature susceptible.

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	-0.74	-0.61	-0.61
Range	-0.383 to -1.154	-0.344 to -0.966	-0.481 to -0.667
Standard Deviation	-0.33	-0.22	-0.09

Q. Settlement Test

The asphaltene settling test is used to evaluate the relative degree of dispersion of asphaltenes from paving asphalts. This test distinguishes differences in asphaltene settling times of asphalts in the hexane-maltene solutions. The test involves digesting asphalt in n-hexane, transferring the contents into a graduated cylinder, and measuring the time required for the asphaltene meniscus to settle to the 25 ml. mark of a 50 ml. cylinder. Slower settling times indicate a greater degree of dispersion of the asphaltenes and thus a more compatible asphalt, which in turn is considered to be an important property that contributes to asphalt durability. The test is extremely sensitive to changes in asphalt composition.

Time is reported in minutes.

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	59.9	66.6	76.2
Range	26.75-108.33	22.4-111.95	32.75-113.95
Standard Deviation	28.3	29.9	34.5

R. Asphalt Composition Anslysis

The purpose is to separate the four generic fractions present in asphalt. These fractions are saturates, naphthene aromatics, polar aromatics, and asphaltenes. The relative amount of each fraction plays a role in determining the physical properties of the asphalt. These properties include viscosity, ductility, softening point and temperature susceptibility.

The procedure follows:

The percent asphaltene is determined by dispersing the asphalt in n-heptane and refluxing. The insolubles are the asphaltenes.

The remaining three fractions are determined by adsorbing the deasphaltened n-heptane solution on a calcined alumina chromatography column and eluting (removing) each fraction with a different solvent. Saturates are eluted with n-heptane. Naphthene aromatics are eluted with toluene. Polar aromatics are eluted with 50/50 toluene-methanol solution, followed by trichloroehylene. The solvents are then evaporat and weight percentages of each fraction with respect to the original asphalt sample are determined.

ASPHALTENES

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	11.0	13.3	12.7
Range	8.5-12.9	10.0-15.3	11.6-13.5
Standard Deviation	1.9	1.9	0.8

SATURATES

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	10.4	10.1	10.8
Range	9.0-12.1	8.2-13.9	9.4-12.8
Standard Deviation	1.3	1.8	1.4

NAPHTHENE AROMATICS

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	32.9	31.9	32.4
Range	28.1-35.6	29.0-34.1	30.2-33.9
Standard Deviation	2.7	2.0	1.6

POLAR AROMATICS

	AC-10	AC-20	85-100
No. Samples	6	9	4
Mean	41.8	42.1	42.2
Range	39.6-46.3	39.8-47.1	41.1-43.3
Standard Deviation	2.7	2.5	1.1

AC	Supplier	Location	Lot	Crude	P.V.N	Settlement Test Min	Asphaltenes %	Saturates %	Naphthene Aromatics %	Polar Aromatics %
10	Arco	Albany	46/47	Normal	0.740	26.75	9.0	8.9	35.6	41.7
10	Ashland	Tonawanda	34	Normal	1.092	71.20	11.0	12.1	31.8	39.6
10	Exxon	Bayway	-	Normal	0.383	57.33	12.6	10.3	34.7	39.6
10	Marathon	Tonawanda	9	Mid-Cont.	0.630	39.90	11.8	9.3	28.1	46.3
10	Petrofina	Montreal	-	Normal	0.414	108.33	12.9	11.6	32.6	39.8
10	United Ref.	Warren	25	Normal	1.154	55.97	8.5	9.0	34.5	43.5
				$\bar{x}$	0.74	59.9	11.0	10.4	32.9	41.8
				σ	0.33	28.3	1.9	1.3	2.7	2.7
20	Arco	Phila	-	Normal	0.644	27.27	10.6	10.2	34.0	41.8
20	Ashland	Tonawanda	15	Normal	0.932	74.50	12.9	10.6	29.2	41.5
20	Chevron	Perth Amboy	40	Boscan	0.466	22.40	14.5	8.5	31.6	43.2
20	Exxon	Bayway	-	Normal	0.488	73.30	15.0	11.0	32.2	40.3
20	Marathon	Tonawanda	8	Mid Cont.	0.640	43.55	14.0	8.2	29.0	47.1
20	Petrofina	Montreal	-	Normal	0.467	93.40	14.2	10.4	33.8	40.2
20	United Ref.	Warren	27	Normal	0.966	71.17	14.0	8.3	34.1	44.7
20	West Bank	Kearny	4	Boscan	0.502	81.62	13.0	9.4	32.6	40.5
20	West Bank	Pennsauken	1	Normal	0.344	111.95	15.3	13.9	30.3	39.8
				$\bar{x}$	0.61	66.6	13.3	10.1	31.9	42.1
				σ	0.22	29.9	1.9	1.8	2.0	2.5
85/100	B.P.O.I	Montreal	23/24	Canadian	0.687	32.75	12.5	9.4	32.6	43.0
85/100	Gulf	Montreal	-	Normal	0.481	90.00	13.5	12.8	30.2	43.3
85/100	Petrofina	Montreal	23	Normal	0.603	68.25	11.6	10.6	32.9	41.1
85/100	Shell	Montreal	3	Normal	0.667	113.95	13.2	10.5	33.9	41.5
				$\bar{x}$	0.61	76.2	13.7	10.8	32.4	42.2
				σ	.09	34.5	0.8	1.4	1.6	1.1

AC	Supplier Location Lot Crude	Visc 140	CERT	Visc 275	Pen 77	CERT	Pen 39.2	Pen Ratio	TFOT Loss %	TFOT Ductility 60°	TFOT Ductility 77°	TFOT Visc Ratio	TFOT Pen 77	TFOT Pen Ratio %	TFOT Ductility 39.2	TFOT Ductility 77	Flash Point F	Solubility %	P.V.N.	Settlement Test Min	Asphaltenes %	Saturates %	Naphthene - Polar Aromatics %	Naphthene - Polar Aromatics %
10	Arco Albany 46/47 Normal	1075	1044	310	89	93	29	33	+.060 Gain	150	150	1.8	60	67	5.75	150	645	99.83	-0.740	2675	9.0	8.9	35.6	41.7
10	Ashland Tonawanda 34 Normal	1088	1055	270	77	88	23	30	.030	54.5	150	3.1	53	69	6.75	150	589	99.81	-1.092	71.20	11.0	12.1	31.8	39.6
10	Exxon Bayway - Normal	995	1037	314	120	121	40	33	.012	150	150	3.1	75	63	19.5	150	586	99.84	-0.383	57.33	13.6	10.3	34.7	39.6
10	Marathon Tonawanda 9 Mid-Cont.	1062	1090	294	106	116	33	30	.153	150	150	2.1	65	61	13.0	150	543	99.93	-0.630	39.90	11.8	4.3	28.1	46.3
10	Petrofina Montreal - Normal	1032	976	316	116	121	43	37	.108	127	150	2.3	72	62	11.0	150	581	99.94	-0.414	108.33	13.9	11.6	32.6	39.8
10	United Ref. Warren 25 Normal	1312	1207	275	63	66	19	30	+.052 Gain	96	150	1.9	49	78	9.75	150	642	99.88	-1.154	55.92	8.5	9.0	34.5	43.5
	$\bar{x}$	1062	1068	300	95	101	31	32	.05	131	150	2.1	62	67	10.9	150	588	99.87	-0.74	59.9	11.0	10.4	33.9	41.8
	σ	78.6	77.4	17.4	22.7	22.2	9.4	2.8	.06	39	—	0.2	10.3	6.4	5.1	—	39	.05	-0.33	28.3	1.9	1.3	2.7	2.7
20	Arco Phila - Normal	1784	1720	405	67	70	21	31	+.063 Gain	104	150	1.9	46	69	3.75	150	660	99.86	-0.644	27.27	10.6	10.2	34.0	41.8
20	Ashland Tonawanda 15 Normal	1801	1841	374	56	64	18	32	.007	15.5	150	2.2	40	71	5.25	150	600	99.81	-0.932	74.50	12.9	10.6	29.2	41.5
20	Chevron Perth Amboy 40 Boscan	1891	1875	422	75	79	23	31	+.037 Gain	118	150	2.1	51	68	6.25	150	620	99.84	-0.466	32.40	14.5	8.5	31.6	43.2
20	Exxon Bayway - Normal	2116	2201	434	73	74	25	34	.008	44.5	150	3.4	46	63	5.75	150	612	99.91	-0.488	73.30	15.0	11.0	32.2	40.3
20	Marathon Tonawanda 8 Mid-Cont.	1726	1750	371	76	79	26	34	.110	111.5	150	2.3	48	63	6.25	150	572	99.95	-0.640	43.55	14.0	8.2	29.0	47.1
20	Petrofina Montreal - Normal	2087	1930	426	74	78	30	41	.046	37	150	2.1	52	70	5.75	150	588	99.90	-0.467	93.40	14.2	10.4	33.8	40.2
20	United Ref. Warren 27 Normal	1689	1722	365	56	55	17	30	+.031 Gain	33	150	2.0	39	70	7.00	150	647	99.92	-0.966	71.17	14.0	8.3	34.1	44.7
20	West Bank Kearny 4 Boscan	1745	1749	389	81	79	28	35	.250	114	150	2.4	52	64	8.25	150	575	99.95	-0.502	81.62	13.0	9.4	32.6	40.5
20	West Bank Pennsauken 1 Normal	3101	2111	437	80	78	25	31	+.005 Gain	22	150	2.8	49	61	6.25	150	595	99.91	-0.344	111.95	15.3	13.9	30.3	39.8
	$\bar{x}$	1882	1878	401	71	73	24	33	.05	67	150	2.2	47	67	6.1	150	608	99.89	-0.61	66.6	13.3	10.1	31.9	42.1
	σ	174	175	27.3	9.4	8.5	4.4	3.4	.08	43.9	—	0.3	4.8	3.8	1.2	—	30	.05	-0.22	29.9	1.9	1.8	2.0	2.5
85/100	B.P.D.I Montreal 23/24 Canadian	1252	1330	321	89	90	28	31	.036	150	150	2.1	57	64	7.25	150	588	99.86	-0.687	32.75	12.5	9.4	32.6	43.0
85/100	Gulf Montreal - Normal	1743	1932	391	82	83	30	37	+.032 Gain	83	150	2.3	56	68	7.00	150	604	99.94	-0.481	90.00	13.5	12.8	30.2	43.3
85/100	Petrofina Montreal 23 Normal	1296	1356	348	86	88	31	36	+.042 Gain	118	150	1.9	58	67	8.50	150	631	99.79	-0.603	68.35	11.6	10.6	32.9	41.1
85/100	Shell Montreal 3 Normal	1325	1390	339	84	90	28	33	+.036 Gain	45.5	150	2.1	58	69	7.25	150	647	99.88	-0.667	113.75	13.2	10.5	33.9	41.5
	$\bar{x}$	1404	1487	350	85	88	29	34	.01	99	150	2.1	57	67	7.50	150	615	99.87	-0.61	76.2	12.7	10.8	32.4	42.2
	σ	228	299	29.7	3.0	3.3	1.5	2.8	.02	45	—	0.2	1.0	2	0.7	—	25	.06	-.09	34.5	0.8	1.4	1.6	1.1